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RECONNAISSANCE STUDY

FOR A

RAILROAD GRADE SEPARATION

IN

GLENDIVE, MONTANA

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Prepared By:
MONTANA DEPARTMENT OF HIGHWAYS
PRECONSTRUCTION BUREAU
AUGUST, 1976

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A STUDY
ON
DESIGNS AND COSTS
FOR A
RAILROAD GRADE SEPARATION
IN
GLENDIVE

AUGUST, 1976

MONTANA DEPARTMENT OF HIGHWAYS

PRECONSTRUCTION BUREAU

HELENA, MONTANA 59601

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INTRODUCTION

The purpose of the report is to analyze and determine if a grade separation is possible within allowable design standards. The analysis also considers the costs and warrants for such a separation.

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SUMMARY

In the analysis for a railroad grade separation, between Merrill Avenue and North Anderson Avenue, the Department of Highways has considered various locations along with the designs, costs, and justification for such a separation.

An overpass structure was considered it the northeast edge of the Glendive city limits and it was found that it would not be feasible.

The underpass would be located approximately four and one-half blocks southwest of the overpass location. Designs for this separation are below standard unless some changes are made in the profile of Merrill Avenue. However, it is much more in the realm of possibility than the overpass separation. The costs for the underpass facility without a change in the grades along Merrill Avenue would vary from $730,000 to $915,000 depending on the roadway width utilized.

A preliminary study was made of the warrants for a grade separation. Included in the study were anticipated train and traffic growths. Although train numbers are increasing through development of coal areas and future land uses related to vehicle crossings are developing in the vicinity of the proposed railroad separation, the separation (s) are really not warranted. When using Hazard Indices to determine what is justifiable, it is found that an at-grade crossing with flashing lights and automatic gates would suffice for many years.

MAP OF GLENDIVE MONTANA

REPORT ANALYSIS

The Department of Highways was requested by the Glendive City Officials to investigate the possibility of constructing a grade separation over or under the Burlington Northern Railroad at some location between Towne Street and Interstate 94.

At the present time Glendive has only one railroad grade separation, which is on Barry Street, approximately five blocks southwest of Towne Street. This separation services the southwestern section of Glendive. The northeastern section of Glendive is served by two at-grade crossings of the railway. Due to the increase in train traffic traveling easterly from the coal fields, through Glendive, these two at-grade crossings are often blocked for short periods. The blockage of these crossings is aggravating to the residents of the area because police, fire, ambulance, and other vehicles are forced to use the existing separation on Barry Street.

DISCUSSION AND FINDINGS REGARDING GRADE SEPARATIONS

1. Railroad Overpass

The railroad overpass location was originally proposed by Hurlbut, Kersich and McCullough, Consulting Engineers. The Department of Highways slightly changed the location to place it at the most optimum location and increase the length of the grade. Exhibit "A" shows the location of the project in Glendive and Exhibit "B" shows the profile of it. Advantage was taken of the grade difference between the railroad and the two avenues connected by the grade separation.

As shown in the overpass profile, provisions would have to be made for three tracks on 15 foot centers, as indicated by Burlington Northern in a letter dated December 31, 1975. The vertical clearance for the over-

EXHIBIT "A"

GLENDIVE
GRADE SEPARATION

SCALE 1" = 200'±

THIS IS THE ABSOLUTE MINIMUM VERTICAL DESIGN USING 8.00 % GRADES AND A CREST VERTICAL CURVE FOR ONLY 20 MPH.

PLEASE NOTE THAT IT JUST WOULD NOT MAKE IT DOWN TO GRADE AT NEITHER MERRILL AVE. NOR ANDERSON AVE.

256' V.C.

+8.00%

-8.00%

℄ MERRILL AVE.

℄ N. ANDERSON AVE

EXISTING TRACK

℄ FUTURE TRACK

℄ FUTURE TRACK

2130

2120

2110

0+00

1+00

2+00

3+00

4+00

5+00

EXHIBIT "B"

pass structure would have to be at least 25 feet to allow for future electrification. Also the structure will require at least 5 feet additional height for beams and deck for a minimum total height of 30 feet from the tracks to the riding surface.

In order to place a vertical curve over the structure to transition from one grade to the other, the feasibility of such a grade separation is completely eliminated. For a crest vertical curve with a design speed of 20 m.p.h. the K factor is 16. With 8% up and down grades the crest vertical curve would have to be 256 feet in length to provide for minimum stopping sight distance. The difference in height between the railroad track and Merrill Avenue is about 13 feet leaving at least 17 feet between the overpass surface height and Merrill Avenue. The separation profile, Exhibit "B", shows why an overpass is not feasible. Utilizing 8% grades, which are quite steep, and a 20 m.p.h. crest vertical curve, the crossroad grade would just not make it down to either Merrill Avenue or Anderson Avenue.

A cost estimate is somewhat meaningless since the overpass facility is not feasible, however, we have prepared estimates for the structures only. The estimates include a 5 foot sidewalk on each side of the structure.

WIDTH	COST
28 feet	$302,000
40 feet	384,720
44 feet	412,200

According to the traffic that is anticipated on such a crossing, our standards would call for a width of about 40 or 44 feet and 28 feet is the minimum that could be considered if it were decided that an exception to

our standards could be made.

2. Railroad Underpass

A railroad underpass was also considered and its location is shown on Exhibit "A". This location was chosen because the railroad is at a higher level than Merrill Avenue and North Anderson Avenue.

Here again a profile was drawn, Exhibit "C", and the future Burlington Northern Railroad plans for three tracks are included. With a design speed of about 20 m.p.h. and the assumption that about 14 feet of vertical clearance would be acceptable, a separation under the railroad would be possible. For this type of structure a beam and deck depth of at least 5 feet would be required. For sag vertical curves with a design speed of 20 m.p.h. the K factor is 24. The required length of vertical curve with 7% grades is computed and found to be 336 feet (the algebraic difference in grades times the K factor). For crest vertical curves with a design speed of 20 m.p.h. the K factor is 16. Even though the vertical curves on the underpass are below a desirable standard, they present a more workable design for a grade separation.

Cost estimates for this facility follow. The structure costs include 5 foot sidewalks on each side of the underpass structure.

ROADWAY WIDTH COSTS

Materials	28 feet	40 feet	44 feet
Curb	3,360	3,360	3,360
Sidewalk	3,560	3,560	3,560
Plant mix surface	1,165	1,665	1,830
Plant mix base	1,440	2,055	2,260
Cr. Base Gr. 5	2,395	3,420	3,765
Tack and Oil	2,150	3,070	3,375
24" Pipe	1,204	1,372	1,428
Underpass Drainage	4,500	4,500	4,500
Excavation	4,550	7,000	7,000
Underpass	502,000	601,467	640,943

(Continued)

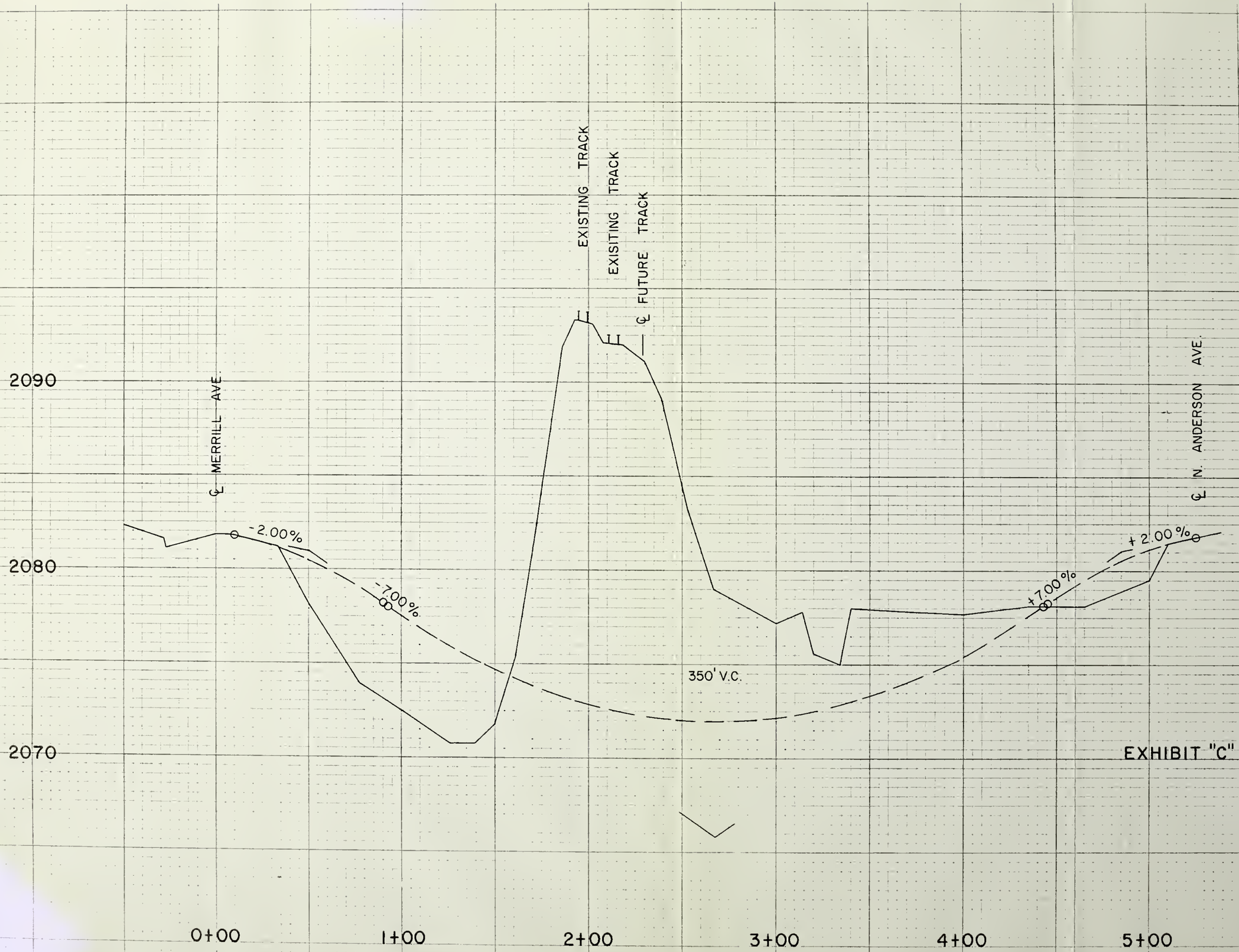

2090
2080
2070
℄ MERRILL AVE.
-2.00%
-7.00%
EXISTING TRACK
EXISITING TRACK
℄ FUTURE TRACK
350' V.C.
+7.00%
+2.00%
℄ N. ANDERSON AVE.
0+00
1+00
2+00
3+00
4+00
5+00

EXHIBIT "C"

Shoofly	50,000	50,000	50,000
Subtotal	576,324	681,469	722,021
10% Misc.	57,632	68,147	72,202
Subtotal	633,956	749,616	794,223
15% Eng. & Contingencies	95,094	112,442	119,133
TOTAL	729,050	862,058	913,357

Thus, the total cost would be about $730,000 to $915,000 depending upon the roadway width decided on for a grade separation underpass.

TRAFFIC VOLUMES AND WARRANTS

In determining what traffic would use a railroad separation at the northeast end of Glendive, volume estimates were derived from existing and anticipated land use developments.

The area to the east of the overpass location is primarily a new single family residential addition which is approximately 75 percent developed. It is anticipated that the Hill Crest subdivision will reach total saturation within four years at the present rate of construction amounting to 10-15 residential structures constructed per year.

Additional subdivisions in the immediate vicinity consist of 80± lots located to the northeast just inside the city limits and an additional estimated 40± lots on land just southeast of the underpass location.

Land use further south of the areas previously mentioned consists mainly of an older established single family neighborhood with an industrial area located adjacent to the Burlington Northern tracks between the Barry Street underpass and the Allard Street at-grade crossing. This area does not appear to be expanding or receiving additional new development.

1. Estimated 1998 Traffic

According to the 1970 to 1974 U. S. Bureau of Census the population

of Glendive has been fluctuating around 6,300. Thus, it is assumed that the construction taking place is largely replacement housing and that the vicinity of the proposed separations will continue to develop at a rate averaging 8 dwelling units per year.

From comparing the number of dwelling units in 1970 to the number of railroad crossings per day (1410 at Griswald, 2780 at Allard, and 9440 at Barry) in 1973, which were not substantially different in 1970, a correlation develops to 10.91 railroad crossings per day per dwelling unit. Review of the 1970 Bureau of Census Data for enumeration districts and adjacent census county divisions indicate 310 dwelling units would be in the area to be served. With traffic distribution, some traffic using the Allard St. at-grade crossing, the estimated 1998 future traffic using a new grade separation at Griswald or Sigmund Street would be close to 4120 vehicles per day.

The above 1998 future traffic of 4120 vehicles per day is based on the assumption that a grade separation would attract some traffic away from the Allard Street at-grade crossing. If the Griswald Street at-grade was left in place and improved, the traffic would not be so attracted from using the Allard Street at-grade. Thus, the traffic would be more evenly distributed and the estimated 1998 traffic would then be 3155 vehicles per day along the Griswald at-grade.

2. Train Traffic

From information thus far received, Burlington Northern has conducted a comprehensive through train study in Glendive and came up with 27 train movements a day. This has been estimated to possibly rise to 35 train movements in the future. This may also have been the reason that Burlington Northern requested that the Department's plans allow for three sets

of tracks.

3. Hazard Indices and Warrants

A hazard index (H.I.) is a system guideline to aid in determining warrants for railroad crossing protection. The system not only bases its warrants on the volume of train and vehicular traffic but also includes consideration of train speed, number of tracks, sight distance, approach angle, highway alignment, number of lanes, approach grades, and local interference.

Upon calculating the H.I. for the future 1998 train and vehicular traffic, 35 and 4120 respectively, at the Griswald Street - Hill Crest Road at-grade crossing it was found that the H.I. would be 5047. Under the present guidelines for urban settings the H.I. under 2000 requires crossbucks, 2000-10,000 requires flashing lights, 10,000-20,000 requires flashing lights and automatic gates, and over 20,000 a grade separation should be provided. As previously mentioned, by just improving the at-grade, the future traffic projections are slightly lower which in turn lowers the H.I. of the crossing. Thus, flashing lights are still the only improvements warranted. Calculations for these H.I. factors are shown in the attachments.

ATTACHMENTS

January 5, 1976

0026:PRD

Mr. D. Peinovich
Director of Engineering
Burlington Northern Railway
2224 Montana Avenue
Billings, Montana 59101

Dear Mr. Peinovich:

Your letter of December 31 to Mr. Beckert concerning a possible railroad grade separation project in Glendive, Montana, has been referred to this department for reply.

We are enclosing a brief prospectus which describes a proposed study of the feasibility for a grade separation project in the northeast section of Glendive. As you will note, this proposed study, if approved by the Federal Highway Administration, will be accomplished by our Preconstruction Division. Hopefully the study will determine whether a grade separation will be feasible from a construction and a funding standpoint. It will not, however, determine the exact location or design details.

We appreciate the information submitted in your letter on the number of tracks planned for this area of Glendive and your recommendations for closing the crossings on Allard and Griswold Streets.

Your future cooperation in the feasibility study will be appreciated and we will attempt to keep you informed on the progress of our planning.

Date Recd. Preconst. 1/6/76

MAIL ROUTE (Act / Info / Attach / Initial)

Beck

34 Hydraulic

Russell

Very truly yours,

H. J. ANDERSON
Director of Highways

By Paul R. DeVine
Paul R. DeVine, Chief
Planning and Research Bureau

PRD:mk

Enclosure

BURLINGTON NORTHERN
ENGINEERING DEPARTMENT
2224 Montana Avenue
Billings, Montana 59101
Telephone (406) 259-4521

RAILWAY COMMISSION
RECEIVED
DEC - 2 1975
HELENA, MONTANA

Glendive
HB 214.5

Mr. Jack R. Beckert
Administrator - Engineering Division
State of Montana
Department of Highways
Helena, Montana 59601

December 31, 1975

Dear Mr. Beckert:

At our meeting with the Glendive City Council on December 2 you indicated that the Highway Department would investigate a proposed grade separation at the east end of Glendive, Montana and you asked us to determine how many tracks we plan to ultimately build in that area.

We expect to have a total of three tracks on 15 foot centers in this area.

When the State has determined a recommended location for the grade separation we would appreciate that information for our further review of our planning for future trackage.

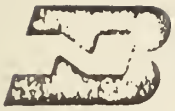
We wish to again recommend that your planning for a grade separation should include elimination of both the Allard Street and Griswold Street grade crossings.

Very truly yours,

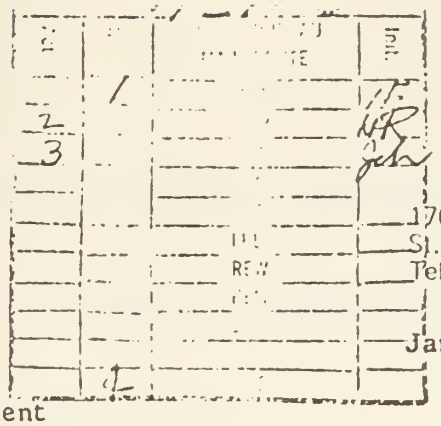
D. Peinovich
Director Engineering

AB/llw

cc: B.G. Anderson
E.N. Martin
C.J. Bryan
W.J. Costle



BURLINGTON NORTHERN



176 East Fifth Street
St. Paul, Minnesota 55101
Telephone (612) 298-2121

ENGINEERING DIVISION

January 22, 1975

Mr. H. J. Anderson
Director of Highways
Montana Highway Department
Helena, Montana 59601

Attention: Mr. Howard E. Stratton, P.E.
Chief, Bridge Bureau

Dear Mr. Anderson:

Reference is made to your letter of November 13, 1974, your file 50-HES, Vertical Road Clearance in which you posed certain questions with respect to our request for 25' vertical clearances over our tracks to provide for electrification.

The following numbered paragraphs refer to similarly numbered paragraphs in your letter:

(1) The time schedule for electrification has not been established but on all new construction and replacements of bridges for our own account, we will immediately begin to provide a minimum 25' vertical clearance.

(2) The tracks in Montana which have been proposed for electrification are as follows:

(a) Former NP mainline from the North Dakota State Line east of Wibaux via Glendive, Billings, Helena, Missoula, Ravalli and Paradise to the Idaho State Line west of Heron.

(b) The line from Nichols to Big Sky.

(c) The line from Sheridan, Wyoming to Decker, Montana.

(3) Vertical clearance at existing bridges would be increased where necessary in the most expeditious and economical way available at the time.

(4) Request for increased vertical clearance for second roadway structures will depend on circumstances. We would request that at least the second structure provide the same vertical clearance as is actually provided by the existing structure.

(5) Insulation requirements will be handled by the Railway as part of the electrification project.

We trust that the above information is adequate for your present requirements.

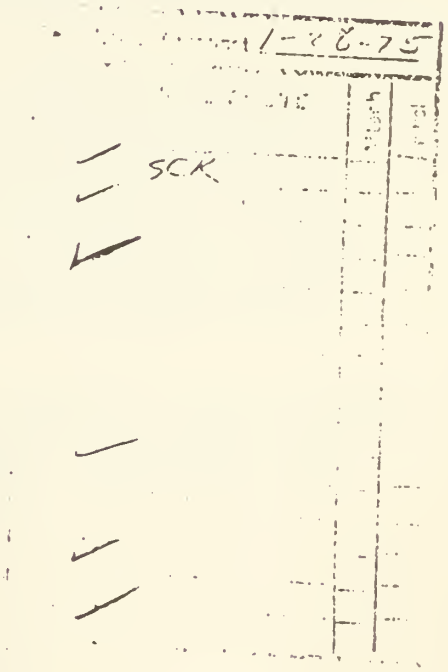
Very truly yours,

K. E. Wyckoff
Director Public Works Planning

REN:blw

cc: Mr. D. Peinovich

File: 323-F



Dave Galaga

STATE OF MONTANA
DEPARTMENT OF HIGHWAYS

September 25, 1975

0026:PRD

Mr. A. T. Kersich, P.E.
Hurlbut, Kersich & McCullough
937 Grand Avenue
Billings, Montana 59102

Dear Mr. Kersich:

Subject: Proposed Glendive Overpass

Thanks for your prompt submittal of the sketches for a proposed railroad grade crossing in Glendive. Since there had been concern expressed as to its physical possibility, we were anxious to take a look at anything feasible.

Our Preconstruction Section reviewed the sketches and have raised some questions and offered some comments. Their comments are repeated here for your consideration.

From our review of the situation, it does not appear that such a separation is feasible. The problem is one of vertical clearance. There just is not room to get up, over, and down.

Over the years, the BN has required that we provide 23 feet of clearance over their track. This, together with beams, deck, and superelevation has required that the finished grade be about 30 feet above the track. Lately however, the BN has been requiring 26 feet of clearance to allow for future electrification. Thus, the finished grade would have to be about 33 feet above the tracks. Also, it appears the consultant placed the deck directly atop the bents without leaving room for beams. Thus, the grade shown on the sketch is considerably too low.

Also, it does not appear that provision was made for vertical curves and naturally they would have to be provided. If we assume that a design speed of 30 m.p.h. would be acceptable, the K factor for

GEORGE [illegible]NOVICH, CHAIRMAN
HELENA

[illegible] BACHELLER
BILLINGS

crests would be 28 and for sags would be 35. With 8% up and 8% down the crest vertical curve would have to be at least 450 feet long and each sag would have to be about 280 feet long. However, that much room is not available.

Also, the width as shown is probably not adequate for any sort of standard no matter how little traffic might be attracted to the facility.

We would recommend that you review the structure and approaches for possible modifications to the proposal or perhaps a suitable alternate.

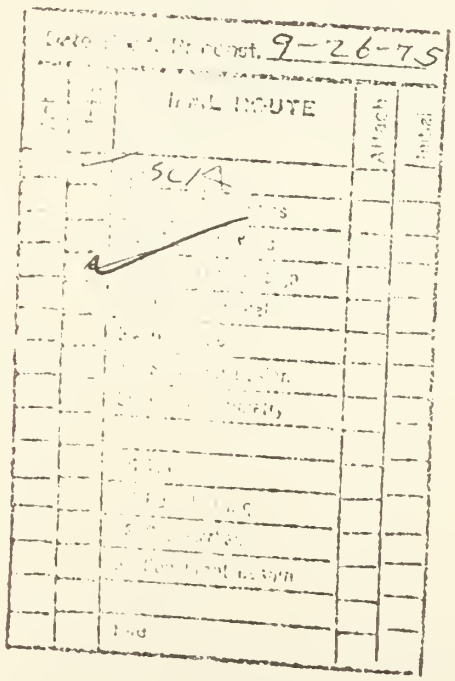
Very truly yours,

H. J. ANDERSON
Director of Highways

By _____
Paul R. Devine, Chief
Planning and Research Bureau

PRD:JWH:mk

cc: Jack R. Beckert
Steve Kologi



FORM 4.A

INTER-DEPARTMENTAL MEMORANDUM

DEPARTMENT OF HIGHWAYS

To Steve Kologi, Chief - Preconstruction

From Paul R. DeVine, Chief - Planning and Research Bureau

Subject: Proposed Glendive Grade Separation

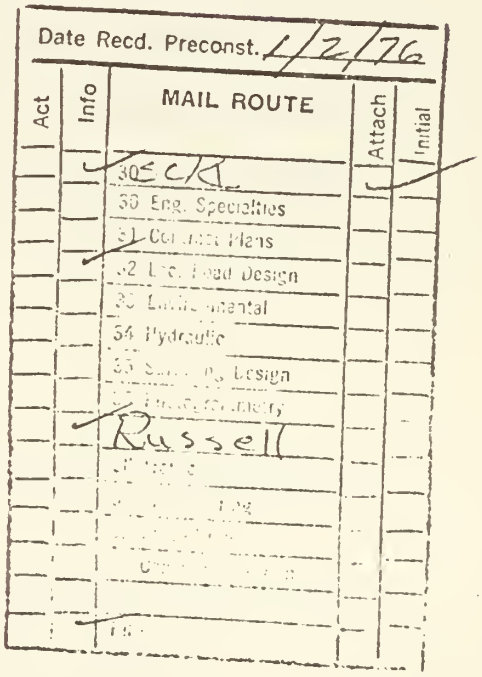
Date December 31, 1975

Attached is a sketch of the proposed Glendive grade separation that was prepared by Hurlbut, Kersich and McCullough for the City of Glendive.

We have prepared a revision to our work program to include an item for the feasibility study for the grade separation of the Burlington Northern Railway. You will be advised of a charge number that can be used after this prospectus has been approved by the Federal Highway Administration. One copy of the proposed prospectus is attached for your information and files.

PRD:mk

Attachment



Avoid Verbal Instructions

PROPOSED PROSPECTUS FOR DETERMINING THE FEASIBILITY OF CONSTRUCTING AN ADDITIONAL GRADE SEPARATION OVER THE BURLINGTON NORTHERN RAILWAY IN GLENDIVE

STATEMENT OF PROBLEM

The Department of Highways has been requested by Glendive City Officials to determine the feasibility of constructing a grade separation over the Burlington Northern Railway at a location between Towne Street and Interstate 94. At the present time Glendive has only one grade separation which consists of an underpass on Barry Street which is west of Towne Street. This separation serves the southwestern section of Glendive. The northeastern section of Glendive east of the Burlington Northern Railway is served by two at-grade railway crossings. Due to the sharp increase in coal train traffic from the coal fields easterly through Glendive, these two crossings are blocked a large portion of the time. The blockage of these crossings is not only aggravating to the residents of the area but it presents a public safety hazard because police and fire vehicles are forced to use the existing separation on Barry Street.

AVAILABLE DATA

1. A 1973 TOPICS plan developed for the City of Glendive by the consultant firm of Morrison-Maierle, Inc.
2. Current average daily traffic volumes on the Federal-aid systems within the Glendive urban area and on the existing railway crossings.
3. Plan and profile of the Burlington Northern Railway through the City of Glendive.

4. Sketches of a proposed overpass in the vicinity of Sigmund Street that were drawn by the consulting firm of Hurlbut, Kersich and McCullough.

PROPOSED STUDIES

It is proposed to proceed with this feasibility study as follows:

1. All available data including traffic volumes aerial photos, contour maps, railroad profiles, etc. will be assembled.
2. Field survey data will be requested as required.
3. Standards will be determined for the study purposes.
4. Preliminary plan and profile sketches will be plotted for several alternates.
5. Cost estimates will be prepared.
6. Final report with recommendations will be prepared for approval by the Department of Highways and the Federal Highway Administration.

These proposed procedures do not include any extensive environmental analysis or public hearings. If a separation does appear to be feasible and fundable, then a preliminary engineering program will be initiated to cover the in-depth studies and analyses.

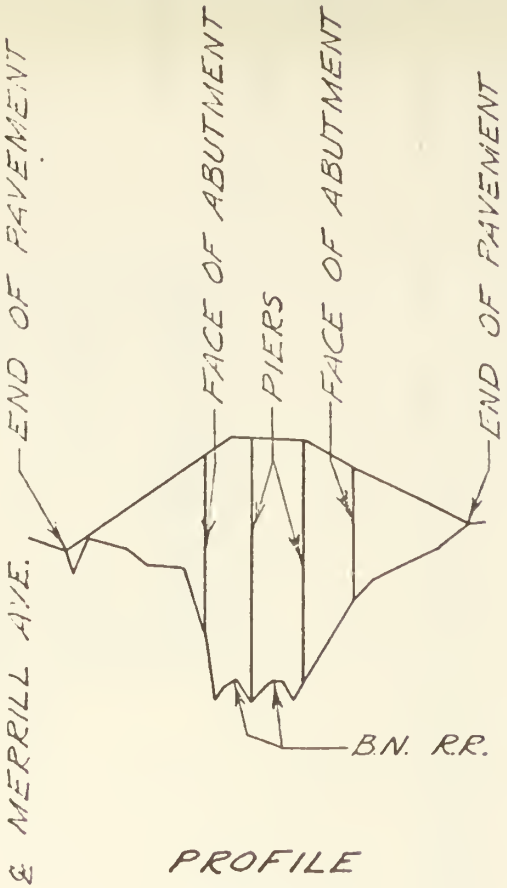
TIME OF COMPLETION

It is estimated that this project will require approximately six months from approval of the prospectus.

ESTIMATED COST AND PROPOSED FINANCING

The estimated total cost of this study is approximately $5,000. It is proposed to finance the cost with HPR funds by transferring $5,000 from Item P-44,

Projects Not Programmed, to Item P-39a, Glendive TOPICS Update. Item P-39a which is an addition to our current work program is being submitted with this prospectus for your approval.



PROFILE

SCALE 1" = 200' HOR.
1" = 20' VERT.

PROPOSED OVERPASS - GLENDIVE
H. K. & M CONS. ENG.

FORM 4 A

INTER-DEPARTMENTAL MEMORANDUM

DEPARTMENT OF HIGHWAYS

To Steve Kologi, Chief - Preconstruction Bureau

From Paul R. DeVine, Chief - Planning and Research Bureau

Subject: Glendive Railroad Separation

Date January 19, 1976

Please refer to your memorandum of December 22, 1975 requesting an estimate of the 1978 and 1998 traffic that could probably use a railroad separation at the northeast edge of Glendive in the vicinity of Sigmund Street.

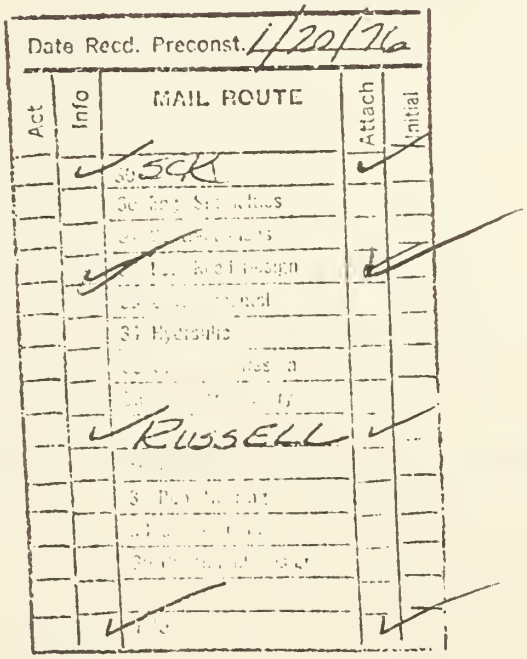
The attached analysis of present and future trip crossings of the Burlington Northern Railway was prepared by Richard Howell. His analysis is based on present and future land use related to vehicle crossings in the vicinity of the proposed railroad separation. We believe that this analysis is a unique approach to the problem of estimating future railroad crossings and it appears to have a considerable amount of merit. We will also send this analysis to the Federal Highway Administration for their comments.

Please advise if you will require any additional information.

PRD:mk

cc: Richard Howell

Attachment



Paul R. DeVine

Avoid Verbal Instructions

Subject: Glendive Railroad Separation Feasibility Study

Problem: Furnish an estimate of the 1978 and 1998 traffic that would use a railroad separation at the northeast edge of Glendive probably in the vicinity of Sigmund Street.

Findings: Estimates of traffic derived from existing and anticipated land use development suggest a 1978 traffic for the railroad separation of 2375 vehicles per day expanding to 4121 by 1998. Local characteristics, assumptions and calculations follow.

Local Characteristics

Land Use

1. The area to the east of the proposed railroad overpass according to the local land use planner is a new single family residential addition which is approximately 75 percent developed. It is anticipated Hill Crest subdivision will reach total saturation within four years at the present rate of construction amounting to 10-15 residential structures constructed a year.
2. Additional subdivisions in the immediate vicinity consist of 82 lots located to the northeast and an additional estimated 42 lots on 14 acres of land proposed to the southeast.
3. Land use to the south of the area previously mentioned within the Glendive corporate limits consists mainly of an older established single family neighborhood with an industrial area located adjacent to the Burlington Northern railroad tracks between the Barry Street underpass and Allard grade crossing. This area does not appear to be expanding or receiving additionl new development.

Population

1. From a review of 1970 to 1974 U.S. Bureau of Census estimates population of Dawson County has been slowly declining. In 1970 the population estimate was 11,269 persons which dropped to 10,900 by 1974.
2. Glendive on the other hand has been remaining stable fluctuating between 6,000 and 6,350 between 1970 and 1974.
3. Review of 1970 Bureau of Census Data for enumeration districts and adjacent census county divisions indicate the following dwelling unit count. (Refer to Enumeration Districts Map)

Area of Proposed Railroad Separation

Enumeration District	Dwelling Units
12	--
13A	268
Adjacent CCD	42
TOTAL DWELLING UNITS	310

Secondary Area of Proposed Railroad Separation

Enumeration District	Dwelling Units
13B	228
14	197
18	372
19	142
20	---
TOTAL DWELLING UNITS	939

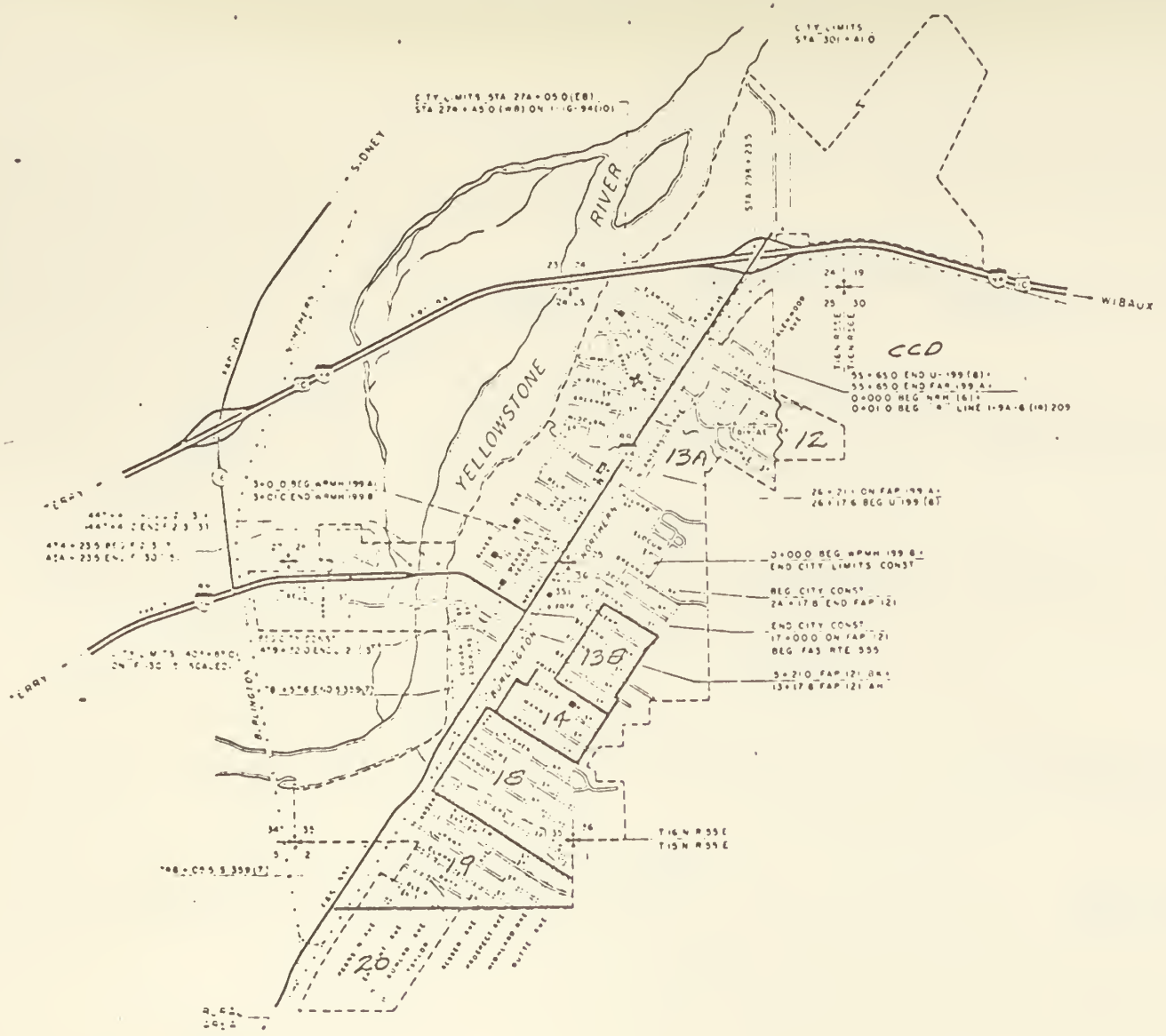
SOURCE: U.S. Bureau of Census - 1970

Railroad Crossing Traffic Counts

In 1973 the following traffic counts were taken at three railroad crossings in the east portion of Glendive. (Refer to Railroad Crossing Location Map)

Griswalt (At Grade Crossing)	1410
Allard (At Grade Crossing)	2780
Barry St. (Underpass)	9440
TOTAL CROSSINGS	13630

SOURCE: Planning and Research



LEGEND

FEDERAL AID HIGHWAY SYSTEMS
PROJECTED ROAD
GRADED AND DRAINED ROAD
GRAVEL OR STONE ROAD
PAVED ROAD
DIVIDED HIGHWAY TRAFFIC FLOW
FAI FEDERAL AID INTERSTATE SYSTEM
FAP FEDERAL AID PRIMARY SYSTEM
FAS FEDERAL AID SECONDARY SYSTEM
INTERSTATE ROUTE MARKER
US NUMBERED ROUTE MARKER
STATE ROUTE MARKER
OTHER ROUTE MARKER
INCORPORATED BOUNDARY LINE
UNIMPROVED DEDICATED STREET
CENTRAL BUSINESS DISTRICT
RAILROAD AND STATION
POST OFFICE
COURT HOUSE
ELEMENTARY SCHOOL
HIGH SCHOOL
HOSPITAL
3000 ELEVATION

T15N R56E

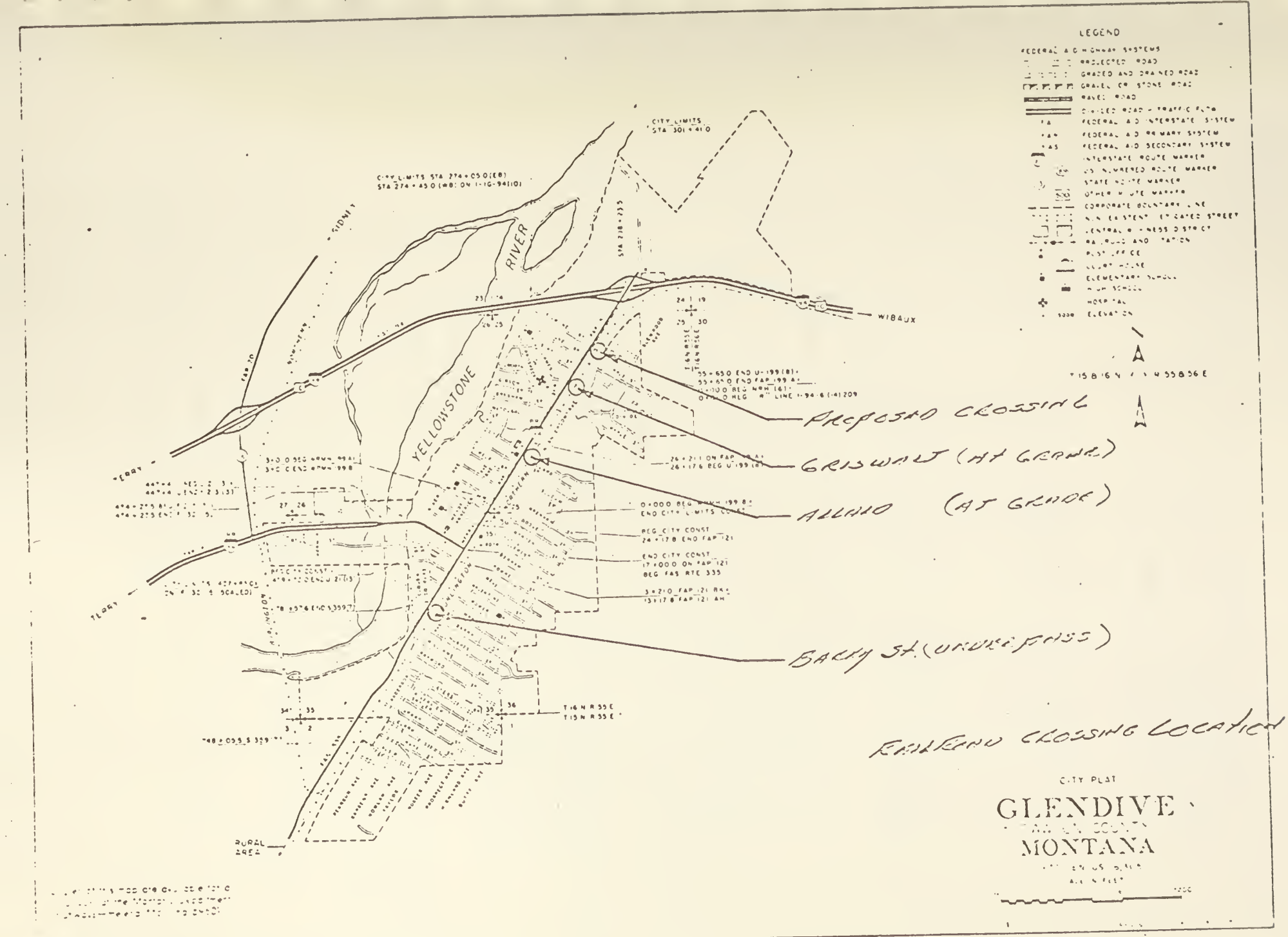
ENUMERATION DISTRICTS

CITY PLAT

GLENDIVE

DAWSON COUNTY

MONTANA


LEGEND
CITY LIMITS STA 301+41.0
CITY LIMITS STA 274+05.0 (EB)
STA 274+45.0 (WB) ON I-16-9411(0)
YELLOWSTONE RIVER
WIBAUX
PROPOSED CROSSING
GRISWALT (AT GRADE)
ALLHO (AT GRADE)
BACHY ST. (UNDEFINED)
EXISTING CROSSING LOCATION
CITY PLAT
GLENDIVE
MONTANA
RURAL AREA
T 16 N R 55 E
T 15 N R 55 E

Assumptions

1. Glendive will not grow substantially in population or increase significantly in dwelling unit numbers over the next twenty years.
2. Housing construction presently taking place is largely replacement housing.
3. The area in the vicinity of the proposed railroad separation will continue to develop as a single family residential area at a rate averaging 8 dwelling units per year.
4. The secondary area of the proposed railroad separation will not significantly change in land use activity or dwelling unit numbers over the next twenty years.
5. An improved north-south collector or arterial system will not be constructed just east of the Burlington Northern railroad tracks.
6. There is a correlation between dwelling unit numbers and railroad crossings. This correlation suggests that there are 10.91 vehicle railroad crossings per dwelling unit.

$$\frac{\text{(Total Railroad Crossings)}}{\text{(Total Dwelling Units)}} \quad \frac{13630}{1249} = 10.91 \text{ railroad crossings/dwelling units}$$

It is anticipated that this relationship will stay the same through 1998 with the exception of the Barry Street underpass which services industrial and commercial activities.

7. The Griswalt at-grade crossing will be eliminated at the time of completion of the the proposed railroad separation in the vicinity of Sigmund Street.
8. Vehicle crossings at the Allard Street grade crossing at the time of completion of the proposed railroad separation will remain the same or less than 1973 traffic crossing volumes.
9. Traffic crossing volumes were not substantially different in 1970 as recorded in 1973 for the three crossings.

Methodology

A. The following presents 1970, 1978 and 1998 vehicle trip crossings per dwelling. 1978 and 1998 calculations include expansions of dwelling units based upon a rate of 8 dwelling units constructed in the area of the proposed railroad separation per year.

1970 VEHICLE TRIP CROSSINGS

Enumeration District	Dwelling Units 1970	Total trip crossings @ 10.91 crossings per D.U.
Area of Proposed Railroad Separation		
12	---	0
13A	268	2924
Adjacent CCD	42	458
TOTAL	310	3382
Secondary Area of Proposed Railroad Separation		
13B	228	2488
14	197	2149
18	372	4059
19	142	1549
20	0	0
TOTAL	939	10245

1978 VEHICLE TRIP CROSSINGS

Enumeration District	Dwelling Units 1970	New Dwelling Units	Dwelling Units 1978	Total Trip Crossings @ 10.91 Crossings Per Dwelling Unit
Area of Proposed Railroad Separation				
12	---	---	---	---
13A	268	40	308	3360
Adjacent CCD	42	24	66	720
TOTAL	310	64	374	4080
Secondary Area of Proposed Railroad Separation				
13B	228	---	228	2488
14	197	---	197	2149
18	372	---	372	4059
19	142	---	142	1549
20	0	---	0	0
TOTAL	939	0	939	10245

1998 VEHICLE TRIP CROSSINGS

Enumeration District	Dwelling Units 1978	New Dwelling Units	Dwelling Units 1998	Total Trip Crossings @ 10.91 Crossings Per Dwelling Unit
Area of Proposed Railroad Separation				
12	---	---	---	---
13A	308	---	308	3360
Adjacent CCD	66	160	226	2466
TOTAL	374	160	534	5826
Secondary Area of Proposed Railroad Separation				
13B	228	---	228	2488
14	197	---	197	2149
18	372	---	372	4059
19	142	---	142	1549
20	0	---	0	0
TOTAL	939	0	939	10245

B. In order to determine the approximate number of vehicles that would utilize the proposed railroad separation it was necessary to find the area traffic composition of the Allard Street grade crossing. Assuming that less than two percent of the vehicles would travel from the area of the proposed railroad separation south to Barry Street underpass or that few vehicles would travel from the Secondary area of the proposed railroad separation to the Griswalt at grade crossing the following estimates of the Allard Street crossing based on dwellings unit concentration were derived as follows:

Area of Proposed Railroad Separation

Total 1970 vehicle crossings generated from area of proposed railroad separation - 3382

RECORDED CROSSINGS

Griswalt	1410
Allard	+2780
	4190
Trip crossings generated	-3382
Trips from Secondary Service Area over the Allard crossing	= 808

Secondary Area of Proposed Railroad Separation

Total 1970 vehicle crossings generated from Secondary Service Area of proposed railroad separation = 10245

RECORDED CROSSINGS

Barry Street	9440
Allard St.	+2780
	12220
Trip crossings generated	-10245
Trips from area of proposed railroad separation over the Allard Crossing	1975

C. If these assumptions are valid then a percent of trip crossings by geographic area can be estimated.

1970 TRIP CROSSINGS DISTRIBUTION

	Area of Proposed Railroad Separation	Secondary Area of proposed RR Separation
Griswalt	$\frac{1350}{3382} = 40.0$	$\frac{55}{10245} = 0.5$
Allard	$\frac{1972}{3382} = 58.3$	$\frac{808}{10245} = 7.9$
Barry Street	$\frac{58}{3382} = \frac{1.7}{100.0\%}$	$\frac{9382}{10245} = \frac{91.6}{100.0\%}$

Allowing for a minor decrease of 100 vehicle crossings at the Allard Street crossing and retaining the Secondary area of the proposed railroad crossing characteristics through 1978 and 1998 the following distribution are obtained.

1978 TRIP CROSSING DISTRIBUTION

Area of Proposed Railroad Crossings	Crossings	Percent
Proposed Overpass near Sigmund (Elimination of Griswalt Crossing)	2320	56.9
Allard	1700	41.6
Barry St.	60	1.5
TOTAL	4080	100.0

Secondary Area of Proposed Railroad Crossing	Crossing	Percent
Proposed Overpass near Sigmund	55	0.5
Allard	808	7.8
Barry Street(Plus 118 to compensate for commercial and industrial land use activities)	9500	91.7
TOTAL	10363	100.0

1998 TRIP CROSSING DISTRIBUTION

	Crossings	Percent
Area of Proposed Railroad Crossing		
Proposed Overpass near Sigmund Elimination of Griswalt Crossing	4066	69.8
Allard	1700	29.2
Barry Street	60	1.0
TOTAL	5826	100.0
Secondary Area of Proposed Railroad Crossing		
Proposed Overpass near Sigmund	55	0.5
Allard	808	7.4
Barry St. (Plus 618 to compensate for commercial andindustrial land use activities)	10000	92.1
TOTAL	10863	100.0

D. Total railroad crossings for each of the railroad crossing locations are included as follows;

TOTAL CROSSINGS

	1978	1998
Proposed Overpass Crossing	2375	4121
Allard St. Crossing	2508	2508
Barry St. Crossing	9560	10060
TOTAL	14443	16689

HAZARD INDEX CALCULATIONS

1. For 1998 ADHT of 4120 and ADTT of 35:

F1 = 2.0	F6 = 0.1	
F2 = 0.8	F7 = 0.0	
F3 = 0.2	F8 = 0.0	F1-10 = 3.5
F4 = 0.0	F9 = 0.1	
F5 = 0.2	F10 = 0.1	

H.I. = ADHT x ADTT x F1-10 / 100
= 4120 x 35 x 3.5 / 100
= 5047

2. For 1998 ADHT of 3155 and ADTT of 35:

H.I. = ADHT x ADTT x F1-10 / 100
= 3155 x 35 x 3.5 / 100
= 3865

POLICY

RAILROAD CROSSING
PROTECTION

July 16, 1973
Date Issued

February 11,19
Date Revised

The need to provide for the safe and orderly movement of traffic along streets and highways under the jurisdiction of the Department of Highways across railroads is the basis of the following guidelines for railroad crossing protection.

HAZARD INDEX

The hazard index is to be used as a guideline to supplemental good judgement in the final determination of what protection is to be provided. In urban and other areas where relatively low speed traffic is encountered, consideration should be given to providing sufficient crossing protection to keep the adjusted hazard index under 2000. However, in rural and other areas where higher speed traffic is encountered, consideration should be given to providing sufficient crossing protection to keep the adjusted hazard index under 200.

The guidelines follow:

URBAN GUIDELINES

H.I.	Protection	Adjusted H.I.
Under 2000	Crossbucks	under 2000
2000-10,000	Flashing Lights	under 2000
10,000-20,000	Gates	under 2000
over 20,000	Separation	None

RURAL GUIDELINES

H.I.	Protection	Adjusted H.I.
Under 200	Crossbucks	under 200
200-1000	Flashing lights	under 200
1000-2000	Gates	under 200
over 2000	Separation	None

HAZARD INDEX FORMULA

$H.I. = (ADHT) \times (ADTT) \times (F_1 + F_2 + F_3 + \text{---} F_{10}) \div 100$

H.I. is the hazard index

(ADHT) is the estimated average daily highway traffic for the design year.

(ADTT) is the estimated average daily train traffic to be encountered during the design year.

When the guidelines are utilized to analyze what type of crossing protection should be provided at a crossing on a proposed construction project, the design year is usually twenty years in the future. However, when the guidelines are utilized to analyze an existing situation, or compare crossings the design year might be the current year.

$(F_1 + F_2 + F_3 \text{---} F_{10})$ is a factor which attempts to give certain values to and summarizes the various physical conditions encountered or anticipated at a crossing site. As currently used this factor has a maximum value of 12.2.

The product of the above three factors is then divided by 100 to obtain a more workable range of hazard index values.

The makeup of the $(F_1 + F_2 + F_3 \text{---} F_{10})$ factor is further described as follows:

F_1 - Type of train movements - maximum value 4.0

use 4.0 for passenger trains over 50 m.p.h.
use 3.0 for freight trains over 50 m.p.h.
use 2.0 for passenger or freight trains under 50 m.p.h.
use 1.0 for switching movements only

F_2 - Trackage - maximum value 0.8

use 0.8 for two mainline tracks plus other tracks
use 0.6 for two mainline tracks
use 0.2 for one mainline track and one or more side tracks
use 0.1 for a single track

F_3 - Sight Distance - maximum value 4.0

Each quadrant ranges in value from 1.0 to 0.0 as the sight distance varies from totally restricted to unlimited.

F_4 - Approach Angle - maximum value 1.6

The value ranges from 1.6 to 00.0 as the crossing angle varies from very flat to a right or nearly right angle.

use 1.6 for 0-20°
use 1.2 for 21°-40°
use 0.8 for 41°-60°
use 0.4 for 61°-80°
use 0.0 for 81°-90°

F_5 - Highway Alignment - maximum value 0.6

use 0.6 if both approaching roadways are on curves over 7°30'
use 0.5 if both approaching roadways are on curves under 7°30'
use 0.4 if one approach roadway is tangent and the other is on a curve over 7°30'
use 0.3 if one approach roadway is tangent and the other is on a curve under 7°30'
use 0.1 if both approach roadways are tangent

F_6 - Number of Lanes - maximum value 0.2

use 0.2 for 4 or more lanes
use 0.1 for 2 lanes

F_7 Approach grades - maximum value 0.2

use 0.2 if both approach grades exceed 7%
use 0.1 if one approach grade exceeds 7%
use 0.0 if both approach grades are under 7%

F_8 - Vertical sight distance - maximum value 0.3

There appears to be some hazard associated with a vehicle being hidden from view on the opposing approach to a crossing. This hazard of non-train collisions is taken into consideration by the vertical sight distance factor.

use 0.3 blind
use 0.0 for open

F_9 - Crossing Width - maximum value 0.2

use 0.2 for 16 feet or less of planked crossing
use 0.1 for planked crossing over 16 feet but under 24 feet
use 0.0 for 24 feet or more of planked crossing

F_{10} - Local Interference - maximum value 0.3

Local traffic entering within 150 feet of the crossing is considered to create additional hazard.

use 0.3 for intersecting street with traffic control
use 0.2 for intersecting street without traffic control
use 0.1 for busy driveway
use 0.0 for no local interference

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